

# LCD Module User Manual

**Customer****:****MASS PRODUCTION CODE****:****TG320240A-05WA0****DRAWING NO.****:****m-TG320240A-05WA0\_A00****Approved By Customer:****Date:**

Approved By	Checked By	Prepared By

***Vatronix Holdings Limited*****ADD:5F,No.10 Blg,WenGuang Industrial Zone,XiLi,Nanshan District,Shenzhen,China****TEL:0086-755-83234801 33207538 FAX:0086-755-33207539****E-mail:sales@Vatronix.com****[Http://www.vatronix.com](http://www.vatronix.com)**

# Contents

1. Precautions in Use of LCD Module-----	P3
2. General Specification-----	P3
3. Absolute Maximum Ratings-----	P3
4. Electrical Characteristics-----	P4
5. Backlight Information-----	P5
6. Optical Characteristics-----	P5
7. Interface Description-----	P6
8. Contour Drawing & Block Diagram-----	P7
9. Application circuit-----	P8
10. Timing Characteristics -----	P9
11. Reset timing -----	P10
12. User instruction Definitions -----	P11
13. Initialization Setting Example -----	P12
14. LCD RAM map -----	P13
15. Standard Character pattern -----	P13
16. Revision records-----	P14

## 1. Precautions in Use of LCD Module

- (1) Avoid applying excessive shocks to the module or making any alterations or modifications to it.
- (2) Don't make extra holes on the printed circuit board, modify its shape or change the components of LCD Module.
- (3) Don't disassemble the LCM.
- (4) Don't operate it above the absolute maximum rating.
- (5) Don't drop, bend or twist LCM.
- (6) Soldering: only to the I/O terminals.
- (7) Storage: please storage in anti-static electricity container and clean environment.

## 2. General Specification

ITEM	STANDARD VALUE	UNIT
Number of dots	320X240	Dots
Outline dimension	139.0(W)X120.0(H)X13.0MAX.(T)	mm
View area	103.0(W)X79.0(H) (5.1 ")	mm
Active area	95.97(W)X71.97(H)	mm
Dot size	0.27 (W)X0.27(H)	mm
Dot pitch	0.30(W)X0.30 (H)	mm
LCD type	FSTN, Negative, transmissive	
View direction	6 o'clock	
Backlight	White LED	
Controller	RA8835	

## 3. Absolute Maximum Ratings

ITEM	SYMBOL	MIN.	TYPE	MAX.	UNIT
Operating Temperature	T <sub>OP</sub>	-20	-	+70	
Storage Temperature	T <sub>ST</sub>	-30	-	+80	
Input Voltage	V <sub>I</sub>	-0.3	-	V <sub>DD</sub> +0.3	V
Supply Voltage For Logic	V <sub>DD</sub>	0	-	5.5	V
Supply Voltage For LCD	V <sub>DD</sub> -V <sub>EE</sub>	0	-	30	V

## 4. Electrical Characteristics

ITEM	SYMBOL	CONDITION	MIN.	TYPE	MAX.	UNIT
Logic Voltage	$V_{DD}-V_{SS}$	-	4.5	5.0	5.5	V
Supply Volt.For LCD	$V_{DD}-V_O$	Ta=25	---	25.0	---	V
Input High Volt.	$V_{IH}$	-	$V_{DD}-2.2$	-	$V_{DD}$	V
Input Low Volt.	$V_{IL}$	-	0	-	0.8	V
Output High Volt.	$V_{OH}$	-	$V_{DD}-0.3$	-	$V_{DD}$	V
Output Low Volt.	$V_{OL}$	-	0	-	0.3	V
Supply Current	$I_{DD}$	-	---	22.0	---	mA

## 5. Backlight Information

### Absolute Maximum ratings (Ta=25 )

Item	Symbol	Conditions	Rating	Unit
Reverse voltage	$V_r$	-	5.0	V
Reverse Current	$I_r$	$V_r=5.0V$	80	$\mu A$
Absolute maximum forward Current	$I_{fm}$		240	mA
Peak forward current	$I_{fp}$	1 msec plus 10% Duty Cycle	240	mA
Power dissipation	$P_d$		755	mW
Operating Temperature Range	$T_{oper}$		-30~+80	
Storage Temperature Range	$T_{st}$		-40~+90	

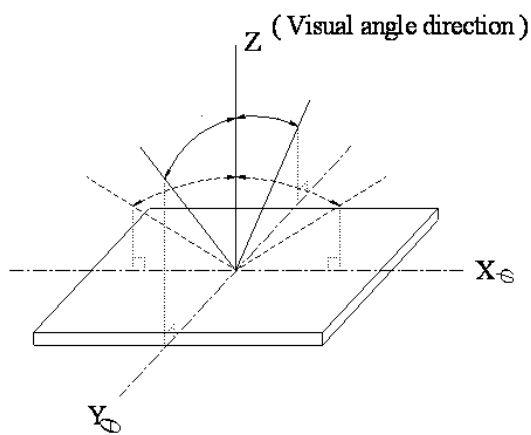
### Electrical/Optical Characteristics (Ta=25°C, If=240mA)

Color	Wavelength $\lambda(nm)$	Spectral line half width (nm)	Operating Voltage(v) ( $\pm 0.15V$ )	Forward Current (mA)
White	---	---	3.1	200

## 6. Optical Characteristics

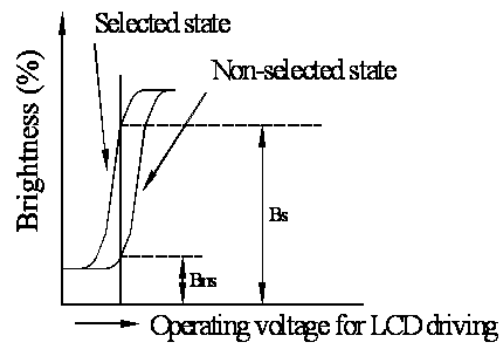
ITEM	SYMBOL	CONDITION	MIN	TYPE	MAX	UNIT
View Angle	(V)	CR 2	10	-	120	deg.
	(H)	CR 2	-45	-	45	deg.
Contrast Ratio	CR	Ta=25°C, Vop	4.0	5.5	8.0	-
Response Time	T rise	-	-	120	180	ms
	T fall	-	-	140	210	ms

### View Angles

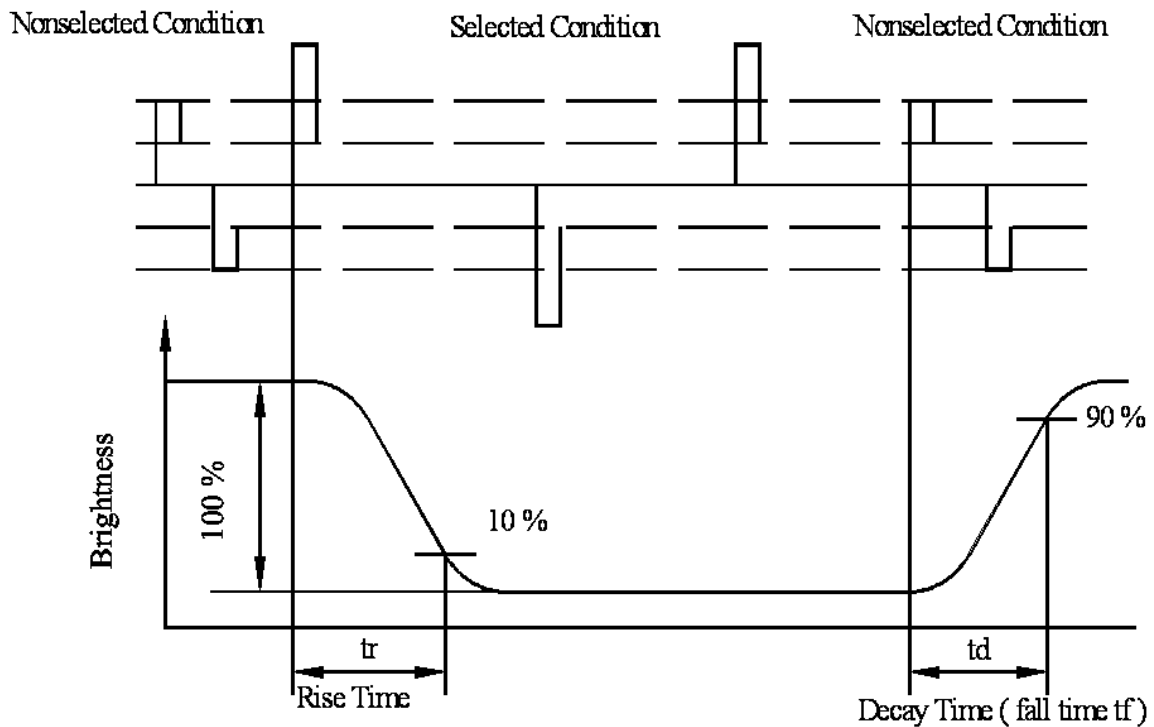


### Contrast Ratio

$$CR = \frac{\text{Brightness at selected state (BS)}}{\text{Brightness at non-selected state (Bns)}}$$



### Response time



## 7.Interface Description

LCD interface CON1:

Pin No.	Symbol	Level	Description
1	V <sub>SS</sub>	0V	Ground
2	V <sub>DD</sub>	5.0V	Power supply for Logic
3	V <sub>0</sub> (V <sub>lcd</sub> )	-20.0V	Driving voltage for LCD
4	/WR(RW)	L (H/L)	8080 family:Write signal,active LOW 6800 family: Read/Write signal
5	/RD (E)	L (H/L)	8080 family:Read signal,active LOW 6800 family: Enable clock
6	/CS	L	Chip enable,active LOW
7	A0	H/L	/RD=L /WR=H A0=L: Data and cursor address Read A0=H :Status read /RD=H /WR=L A0=L: Display data and parameter Write A0=H :Command write
8	/RST	L	LCD reset,active LOW
9~16	DB0~DB7	H/L	8-bit Data bus
17	SEL1	H/L	Microprocessor interface type:H:6800 ,L:8080 Note*
18	V <sub>EE</sub>	-25V	Negative voltage output (Optional)
19	A(LED+)	+5V	Anode of LED Backlight
20	K(LED-)	0V	Cathode of LED Backlight

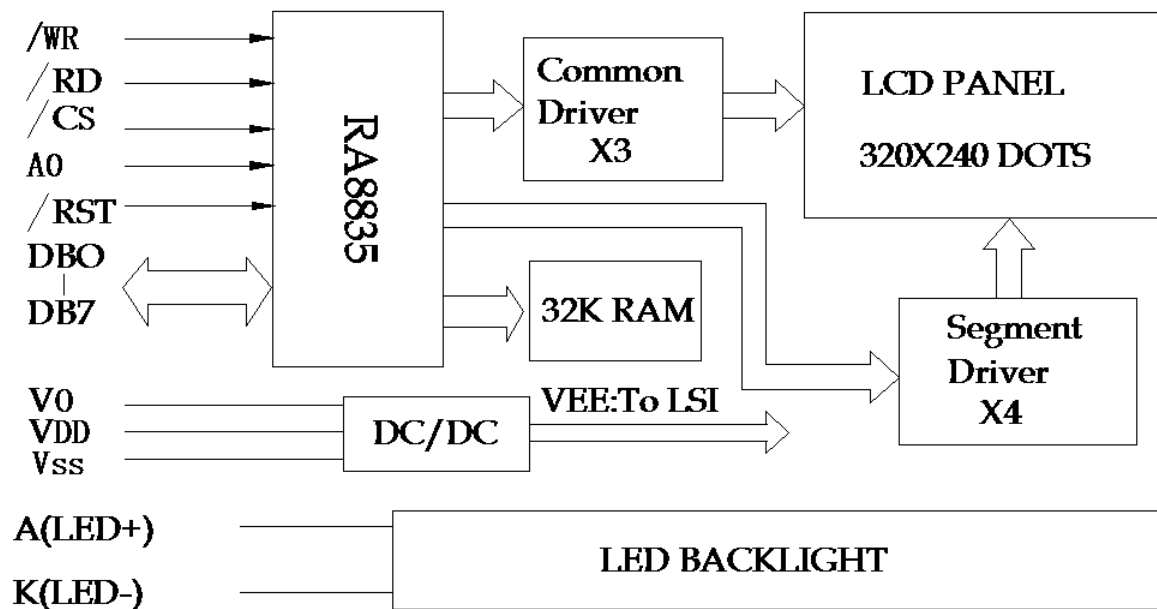
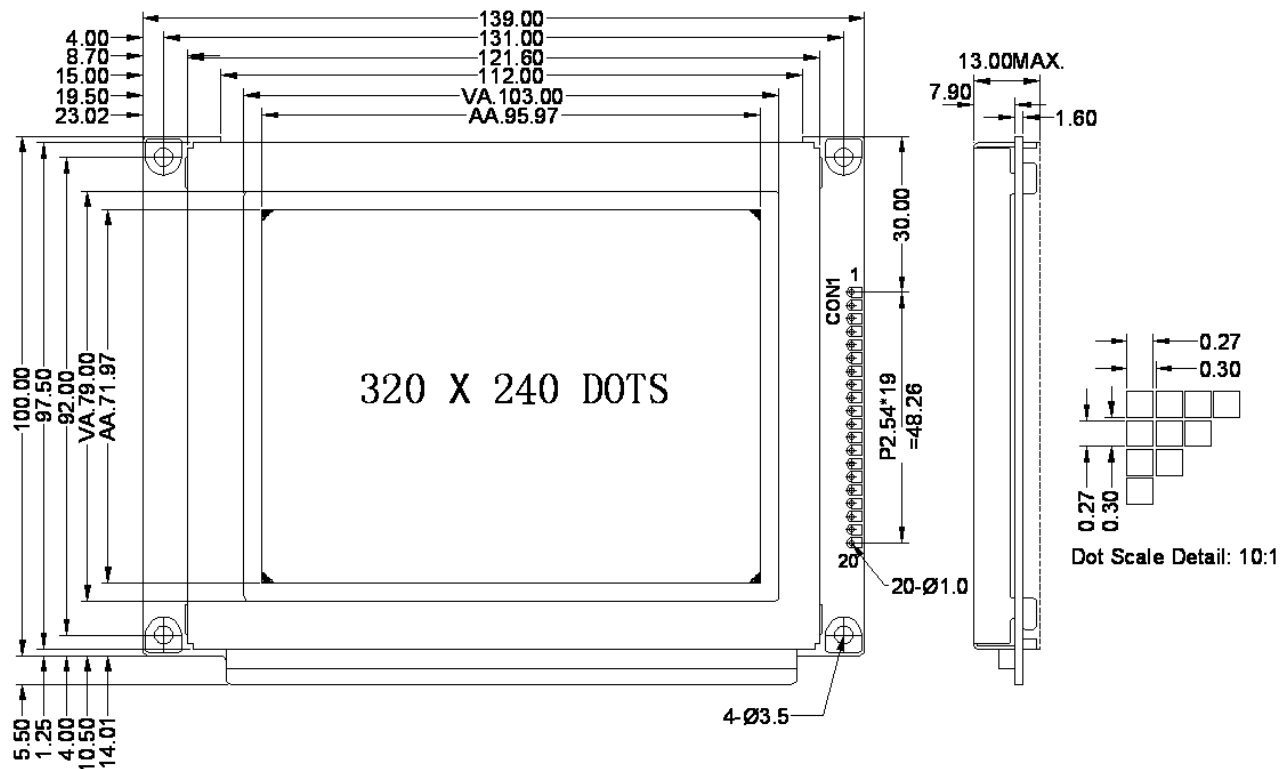
### Note:

Microprocessor interface type is set by jumper J68 and J80 or setting by PIN18 "SEL1"

8080 family:J80=0 Ohms,J68 open.**Default setting.**

6800 family:J68=0 Ohms,J80 open.

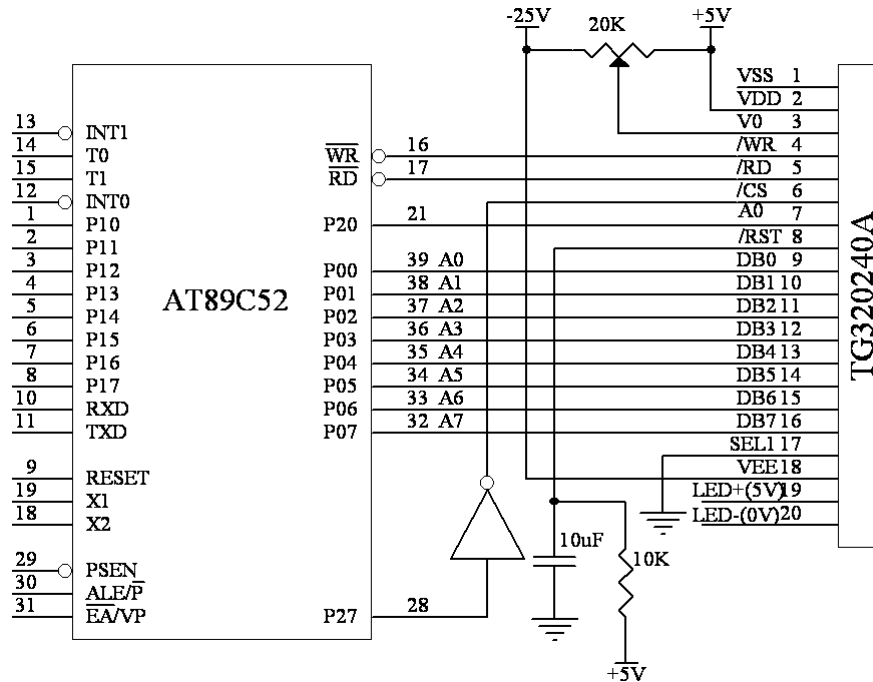
## 8. Contour Drawing & Block Diagram



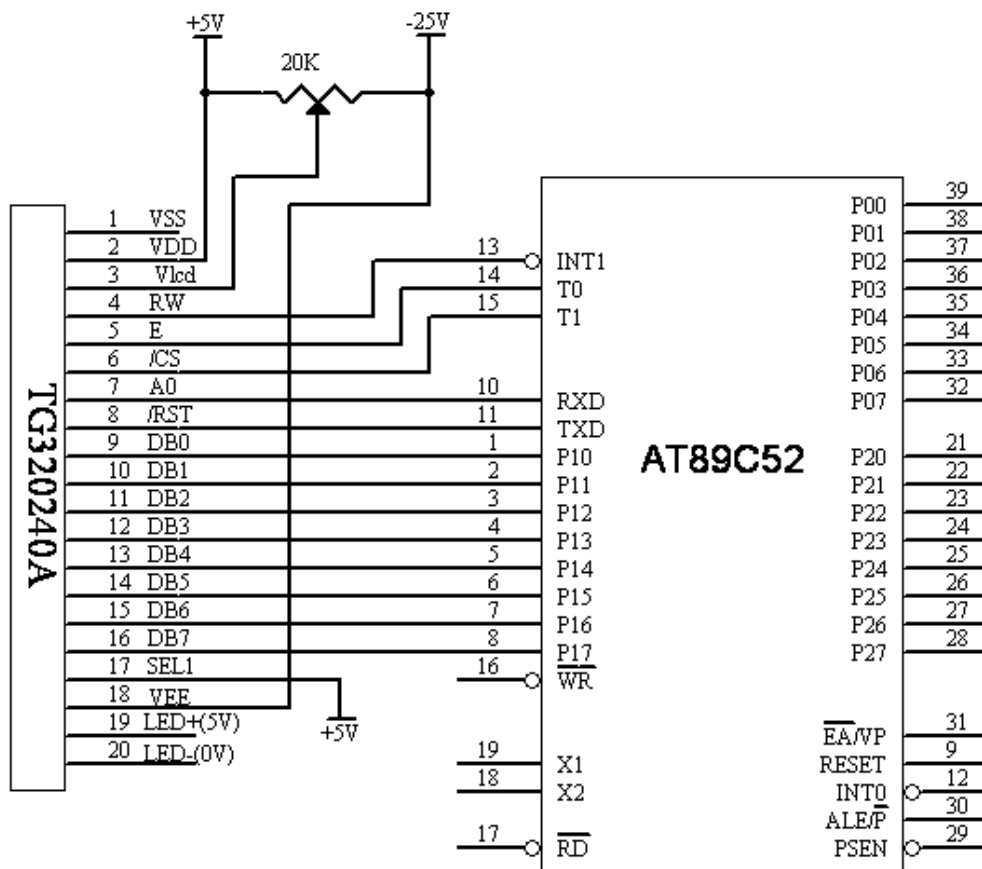
## 9. Application circuit

### 9.1 Interface with the 8080 family MPU

The LCD can be used with an 8080 family MPU as shown in the following application circuit.



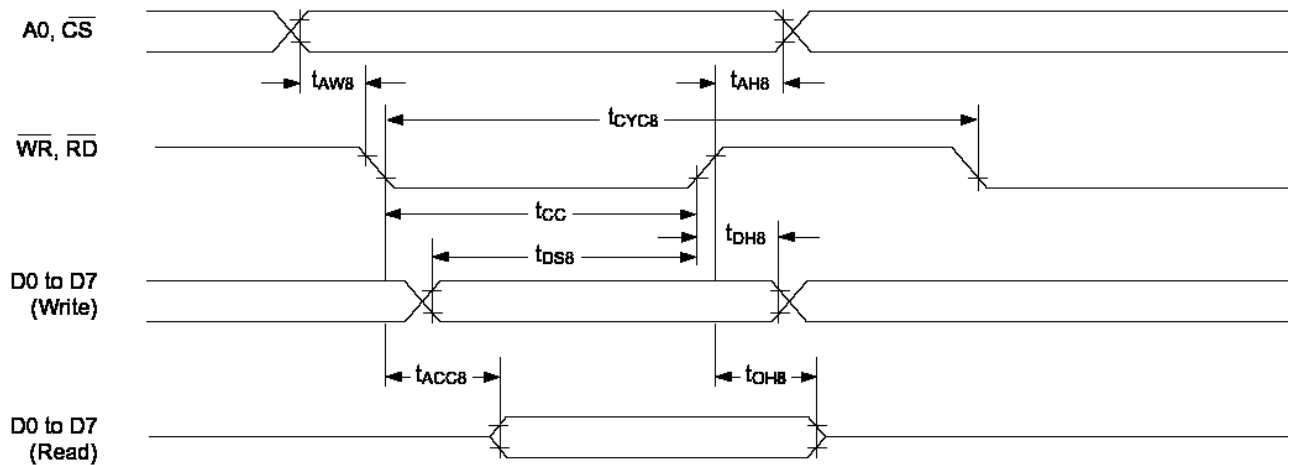
### 9.2 Interface with the 6800 family MPU





## 10. Timing Characteristics

### 10.1 8080 family interface timing



$T_a = -20 \text{ to } 75^\circ\text{C}$

Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
A0, CS	$t_{AH8}$	Address hold time	10	—	10	—	ns	CL = 100pF
	$t_{AW8}$	Address setup time	0	—	0	—	ns	
WR, RD	$t_{CYC8}$	System cycle time	See note.	—	See note.	—	ns	
	$t_{CC}$	Strobe pulsewidth	120	—	150	—	ns	
D0 to D7	$t_{DS8}$	Data setup time	120	—	120	—	ns	
	$t_{DH8}$	Data hold time	5	—	5	—	ns	
	$t_{ACC8}$	RD access time	—	50	—	80	ns	
	$t_{OH8}$	Output disable time	10	50	10	55	ns	

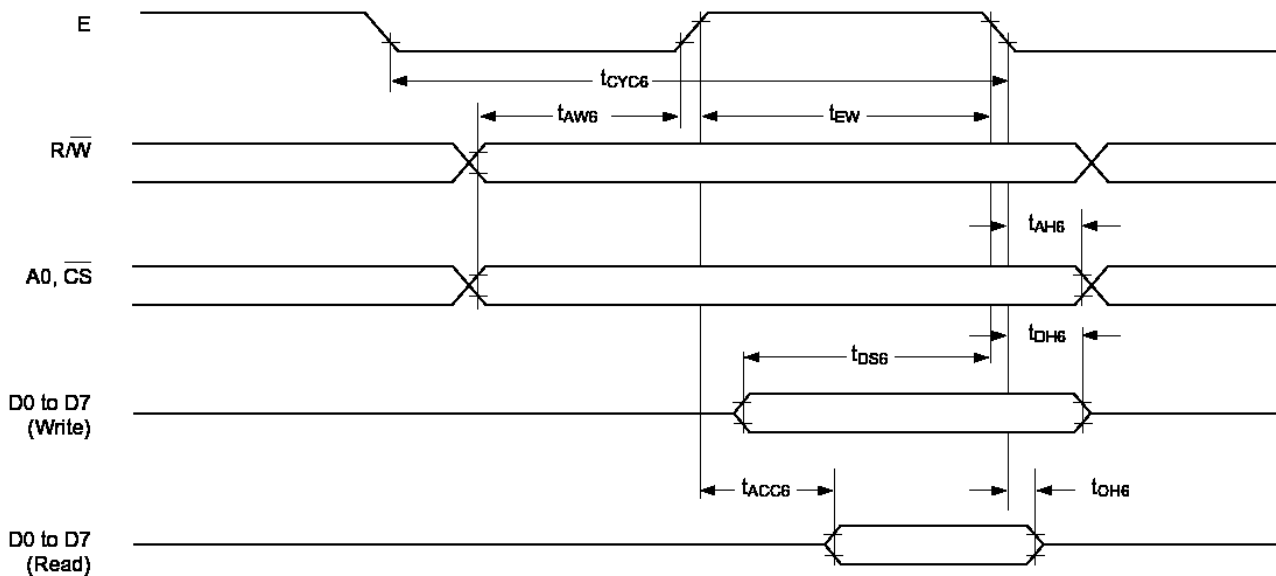
**Note:** For memory control and system control commands:

$$t_{CYC8} = 2t_C + t_{CC} + t_{CEA} + 75 > t_{ACV} + 245$$

For all other commands:

$$t_{CYC8} = 4t_C + t_{CC} + 30$$

## 10.2 6800 family interface timing



**Note:**  $t_{CYC6}$  indicates the interval during which CS is LOW and E is HIGH.

$T_a = -20$  to  $75^\circ\text{C}$

Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
A0, CS, R/W	$t_{CYC6}$	System cycle time	See note.	—	See note.	—	ns	CL = 100 pF
	$t_{AW6}$	Address setup time	0	—	10	—	ns	
	$t_{AH6}$	Address hold time	0	—	0	—	ns	
D0 to D7	$t_{DS6}$	Data setup time	100	—	120	—	ns	
	$t_{DH6}$	Data hold time	0	—	0	—	ns	
	$t_{OH6}$	Output disable time	10	50	10	75	ns	
	$t_{ACC6}$	Access time	—	85	—	130	ns	
E	$t_{EW}$	Enable pulsewidth	120	—	150	—	ns	

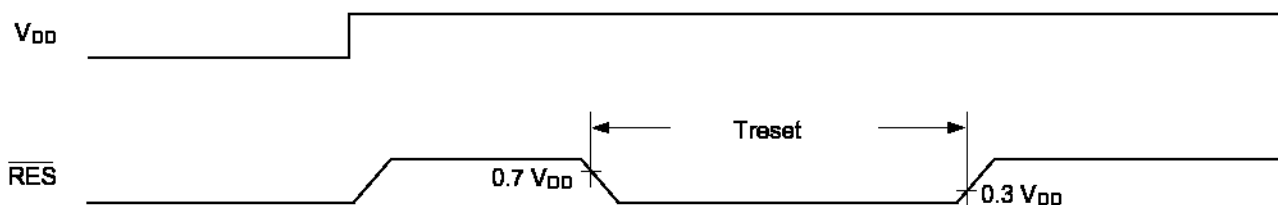
**Note:** For memory control and system control commands:

$$t_{CYC6} = 2t_c + t_{EW} + t_{CEA} + 75 > t_{ACV} + 245$$

For all other commands:

$$t_{CYC6} = 4t_c + t_{EW} + 30$$

## 11. Reset timing



**Reset Timing Diagram**

ITEM	SYMBOL	MIN.	TYPE	MAX.	UNIT
Reset plus	$T_{reset}$	1.0	---	---	ms

## 12. User instruction Definitions

### 12.1 Command Table

Command	Parameter	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	HEX	Descriptions
SYSTEM SET	-	1	1	0	0	1	0	0	0	0	0	0	40	Init device and display (with 8 parameters)
	P1	0	1	0	0	0	IV	1	WS	M2	M1	MD	**	MD=0: Internal CG ROM MD=1: external CG ROM M1=0: no D6 correction M1=1: D6 correction M2=0: 8-pixel char height M2=1: 16-pixel char height WS=0: single panel drive WS=1: dual panel drive IV=0: Screen top-line correction IV=1: No screen top-line correction
	P2	0	1	0	WF	0	0	0	0	FX			**	FX: define the horizontal char size WF=0: 16-line AC drive WF=1: two frame AC drive
	P3	0	1	0	0	0	0	0	FY				**	FY: Vertical Char Size
	P4	0	1	0	C/R								**	C/R: display line address range
	P5	0	1	0	TC/R								**	TC/R: Line length selection
	P6	0	1	0	L/F								**	L/F: Frame Height selection
	P7	0	1	0	APL								**	APL: Horizontal address range (low byte)
	P8	0	1	0	APH								**	APH: Horizontal address range (high byte)
SLEEP IN	-	1	1	0	0	1	0	1	0	0	1	1	53	Enter standby mode
DISP ON/OFF	-	1	1	0	0	1	0	1	1	0	0	D	58 / 59	Enable and disable display and display flashing (with 1 parameter)
	P1	0	1	0	FP5	FP4	FP3	FP2	FP1	FP0	FC1	FC0	**	Each pair of bit in FP sets the attributes of one screen block
SCROLL	-	1	1	0	0	1	0	0	0	1	0	0	44	Set display start address and display regions (with 8 or 10 parameters)
	P1	0	1	0	A7	A6	A5	A4	A3	A2	A1	A0	**	SAD 1L
	P2	0	1	0	A15	A14	A13	A12	A11	A10	A9	A8	**	SAD 1H
	P3	0	1	0	L7	L6	L5	L4	L3	L2	L1	L0	**	SL1
	P4	0	1	0	A7	A6	A5	A4	A3	A2	A1	A0	**	SAD 2L
	P5	0	1	0	A15	A14	A13	A12	A11	A10	A9	A8	**	SAD 2H
	P6	0	1	0	L7	L6	L5	L4	L3	L2	L1	L0	**	SL2
	P7	0	1	0	A7	A6	A5	A4	A3	A2	A1	A0	**	SAD3L
	P8	0	1	0	A15	A14	A13	A12	A11	A10	A9	A8	**	SAD3H
	P9	0	1	0	A7	A6	A5	A4	A3	A2	A1	A0	**	SAD4L (for both two-screen drive and two layer config are select)
	P10	0	1	0	A15	A14	A13	A12	A11	A10	A9	A8	**	SAD4H (for both two-screen drive and two layer config are select)
CSRFORM	-	1	1	0	0	1	0	1	1	1	0	1	5D	Set cursor type (with 2 parameters)
	P1	0	1	0	0	0	0	0	X3	X2	X1	X0	**	CRX
	P2	0	1	0	CM	0	0	0	Y3	Y2	Y1	Y0	**	CRY CM=0: underscore cursor; CM=1: block cursor
CGRAM ADR	-	1	1	0	0	1	0	1	1	1	0	0	5C	Set Start address of char generator RAM (with 2 parameters)
	P1	0	1	0	A7	A6	A5	A4	A3	A2	A1	A0	**	SAGL
	P2	0	1	0	A15	A14	A13	A12	A11	A10	A9	A8	**	SAGH
CSRDIR	-	1	1	0	0	1	0	0	1	1	CD1	CD0	4C~4F	Set Direction of Cursor movement
HDOT SCR	-	1	1	0	0	1	0	1	1	0	1	0	5A	Set horizontal scroll position (with 1 parameters)
	P1	0	1	0	0	0	0	0	0	D2	D1	D0	**	
OVLAY	-	1	1	0	0	1	0	1	1	0	1	1	5B	Set display overlay format (with 1 parameters)
	P1	0	1	0	0	0	0	OV	DM2	DM1	MX1	MX0	**	
CSRW	-	1	1	0	0	1	0	0	0	1	1	0	46	Set cursor address (with 2 parameters)
	P1	0	1	0	A7	A6	A5	A4	A3	A2	A1	A0	**	CSRL
	P2	0	1	0	A15	A14	A13	A12	A11	A10	A9	A8	**	CSRH
CSRR	-	1	1	0	0	1	0	0	0	1	1	1	47	Read Cursor Address (with 2 parameters)
	P1	1	0	1	A7	A6	A5	A4	A3	A2	A1	A0	**	CSRL
	P2	1	0	1	A15	A14	A13	A12	A11	A10	A9	A8	**	CSRH
MWRITE	-	1	1	0	0	1	0	0	0	0	1	0	42	Write to display memory (with n parameters)
	P1	0	1	0	Memory Data								**	Display memory data
	:	:	:	:	:								**	
	Pn	0	1	0	Memory Data								**	
MREAD	-	1	1	0	0	1	0	0	0	0	1	1	43	Read from display memory (with n parameters)
	P1	1	0	1	Memory Data								**	Display memory data
	:	:	:	:	:								**	
	Pn	1	0	1	Memory Data								**	

#### Note:

For details, please refer to RA8835 datasheet.

### 13. Initialization Setting Example

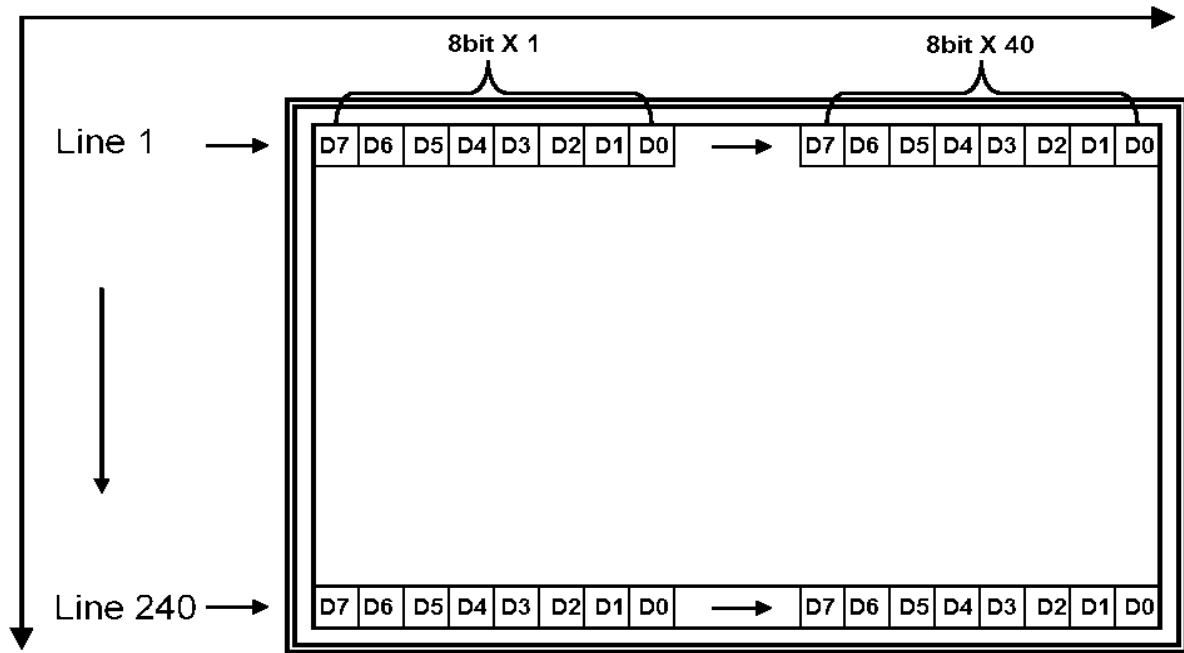
After hardware reset, the following setting command should be executed.

Command	Parameter	A0	RD	WR	Value (binary)	HEX	Descriptions
SYSTEM SET	-	1	1	0	0100 0000	40	Init device and display, (with 8 parameters)
	P1	0	1	0	0011 0000	30	M0=0: Internal CG ROM M0=1: external CG ROM M1=0: no D8 correction M1=1: D8 correction M2=0: 8-pixel char height M2=1: 16-pixel char height W/S=0: single panel drive W/S=1: dual panel drive IV=0: Screen top-line correction IV=1: No screen top-line correction
	P2	0	1	0	1000 0111	87	FX: define the horizontal char size WF=0: 18-line AC drive WF=1: two frame AC drive
	P3	0	1	0	0000 0000	00	FY: Vertical Char Size
	P4	0	1	0	0010 1000	28	C/R: display line address range
	P5	0	1	0	0100 0101	45	TC/R: Line length selection
	P6	0	1	0	1110 1111	EF	LF: Frame Height selection
	P7	0	1	0	0010 1000	28	APL: Horizontal address range (low byte)
	P8	0	1	0	0000 0000	00	APH: Horizontal address range (high byte)
DISP ON/OFF	-	1	1	0	0101 1001	59	Enable
SCROLL	P1	0	1	0	0000 0100	04	
	-	1	1	0	0100 0100	44	Set cursor type (with 8 parameters)
	P1	0	1	0	0000 0000	00	SAD 1L
	P2	0	1	0	0000 0000	00	SAD 1H
	P3	0	1	0	1110 1111	EF	SL1
	P4	0	1	0	0000 0000	00	SAD 2L
	P5	0	1	0	0000 0000	00	SAD 2H
	P6	0	1	0	1110 1111	EF	SL2
	P7	0	1	0	0000 0000	00	SAD3L
	P8	0	1	0	0000 0000	00	SAD3H
CSRDIR	-	1	1	0	0100 1100	4C	Set Direction of Cursor movement
HDOT SCR	-	1	1	0	0101 1010	5A	Set horizontal scroll position (with 1 parameters)
	P1	0	1	0	0000 0000	00	
OVLAY	-	1	1	0	0101 1011	5B	Set display overlay format (with 1 parameters)
	P1	0	1	0	0000 1101	0D	
CSRW	-	1	1	0	0100 0110	46	Set cursor address (with 2 parameters)
	P1	0	1	0	0000 0000	00	CSRL
	P2	0	1	0	0000 0000	00	CSRH
MWRITE	-	1	1	0	0100 0010	42	Write to display memory (with n parameters)
	P1	0	1	0	Memory Data	**	Display memory data
	:	:	:	:	:	**	
	Pn	0	1	0	Memory Data	**	

#### Note:

- 1.For details,please refer to RA8835 datasheet.
- 2.It is an example only,these settings can be changed if necessary.

## 14. LCD RAM map



## 15. Standard Character pattern

		Character code bits 0 to 3															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Character code bits 4 to 7	2		!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/
	3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
	4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
	6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
	7	P	q	r	s	t	u	v	w	x	y	z	{		}	~	
	A		α	β	γ	δ	ε	ζ	η	θ	ι	κ	λ	μ	ν	ξ	ο
	B	—	π	ρ	σ	τ	υ	φ	χ	ψ	ω	Α	Β	Γ	Δ	Ε	Ζ
	C	Θ	Υ	Ψ	Ω	Α	Β	Γ	Δ	Ε	Ζ	Η	Θ	Ι	Κ	Λ	Μ
	D	Ξ	Ο	Π	Σ	Τ	Υ	Φ	Χ	Ψ	Ω	α	β	γ	δ	ε	ζ
1																	

**16. Revision records**

Version	Ref.page	Reversion Items	Date
A00	All	New release	2009.11.28